## San Diego State University Research Foundation

**Title:** Energy Innovations Small Grant Program Natural Gas Research Solicitation 10-01G
**Amount:** $92,955.00
**Term:** 12 months
**Contact:** Patrick McCarthy
**Committee Meeting:** 12/1/2010

### Recommendation

Staff respectfully recommends approving the highest ranking research grant applications from the Energy Innovations Small Grant (EISG) natural gas solicitation 10-01G in the amount of $92,995. Staff recommends placing this item on the discussion agenda of the Energy Commission Business Meeting.

### Issue

The EISG program is a component of the Public Interest Energy Research (PIER) program that is managed by the California Energy Commission. The purpose of the PIER program is to provide benefit to California electricity and natural gas ratepayers by funding energy research, development and demonstration (RD&D) projects that are not adequately provided for by competitive and regulated energy markets.

The Energy Commission recognizes the need for a program to support the early development of promising new energy technology concepts, a niche not covered by PIER general solicitations that focus primarily on development of established concepts. The Energy Commission established the EISG program to meet this need. The EISG program provides up to $95,000 for hardware projects and $50,000 for modeling projects to small businesses, non-profits, individuals and academic institutions to conduct research that establishes the feasibility of new, innovative energy concepts. Research projects must target one of the PIER program areas, address a California energy problem and provide a potential benefit to California electricity and natural gas ratepayers.

### Background

The Energy Commission has conducted the EISG program since its initiation in 1998 by issuing multiple competitive solicitations per year for new and innovative concepts that, if proven feasible, are expected to open new paths to public interest energy research and development and subsequent public benefit. Three annual surveys of completed projects show that 50 percent of the completed projects attract follow-on RD&D funding from a wide variety of sources, thus enabling the innovative development to continue beyond EISG grant funding. The gross follow-on funding is some 30 times the total Energy Commission grant funding to all completed EISG projects since the beginning of the program. Approximately 85 percent of the follow-on development work is located in California.

### Proposed Work

The Energy Innovations Small Grant Program solicitation 10-01G yielded the following response:

- 8 grant applications were received for consideration

- 5 passed initial screening and advanced to technical review
- 5 exceeded the minimum required score in technical review and advance to the PTRB
- 1 proposals were recommended for funding by the PTRB valued at $92,995.

The proposal that is being recommended for funding is as follows:

Project Title: Development of Energy Efficient Dehulling and Drying Methods for Walnuts
Principle Investigator: Griffiths G. Atungulu, UC Davis (Davis, CA)
Rank: 1
Amount: $92,995 - 2nd Submittal
Project Summary:

This project seeks to reduce natural gas use associated with harvesting and drying walnuts. The primary source of potential efficiency gains is the large variability of moisture content in harvested nuts; due to the single batch methods currently used for drying the harvest, as much as 60 percent of the energy used is in excess of that which is required. The PI will work in coordination with the California Walnut Board to identify methods of dehulling, sorting, and drying that will provide significant benefits to the industry. California currently produces almost 99 percent of the US walnut harvest.

## Development of Energy Efficient Dehulling and Drying Methods for Walnuts

**Principal Investigators: Griffiths G. Atungulu and Zhongli Pan**

## Project Summary

The California walnut industry has two major needs, reducing energy use and improving processing efficiency, in postharvest operations. The industry consists of 5,300 walnut growers and 55 walnut processors and produces nearly 400 thousand tons of walnuts which are almost 99% of the U.S. walnuts production. However, walnut drying is a very energy intensive processing step which requires on average 12 therms of natural gas or 13 gallons of propane and 24 kWh of electricity per ton of dried nuts and inefficient operations may even use twice as much. One of the major reasons causing the high energy consumption is because walnuts are currently dried in a single batch despite the huge variability in moisture contents (MC) of individual nuts at harvest. To achieve the average safe storage MC of walnuts, a significant portion of nuts in each batch is over-dried. The larger the moisture variation of nuts is at entering a dryer, the more nuts are over-dried. The over-drying results in 6 to 8 hr of additional drying time and represent 40% to 60% of total drying time and energy use. Also, the mixed walnuts with- and without-hull are transported to drying site for wet-dehulling. This practice uses a significant amount of energy for transporting the hulls attached on nuts from farms to drying sites and away from drying sites to landfields. To reduce energy use, we propose to sort walnuts based on hull attachment, followed by dry-dehulling in the orchard, then the walnuts are sorted again based on MC of individual walnuts before drying. The sorted walnuts with reduced MC variation can be separately dried. In addition, because of the large difference in MC between shell and kernel, part of the moisture in shell could be quickly removed by using high temperature or infrared drying without affecting the product quality. These proposed measures should provide effective solutions for the challenges faced by the industry and growers, achieve reduced energy use and production cost, and at the same time make the product more competitive on the global market. Our preliminary results have proven that our proposed approaches are feasible and practical.

With the support from the California Walnut Board (CWB), we determined that the energy cost of dehulling and drying is a significant portion of total postharvest cost. Our preliminary results revealed a huge variability in MC among individual walnuts at harvest, which ranged from 5-50% (wet basis). The shell MC was also much higher (4-10%) than kernel MC and a very strong correlation between shell and kernel MC exists at harvest. Therefore, the shell moisture can be used as an effective indicator for sorting walnuts before drying to achieve improved drying efficiency with much reduced energy use and drying time. At present, however, there are no methods for sorting walnuts based on MC or size. Therefore, the objectives of this proposed research are as follows:

1. Determine the physical characteristics of walnuts with- and without-hull for in-field sorting.
2. Develop dry-dehulling technology for in-field dehulling.
3. Develop new near infrared reflectance (NIR) sorting method based on MC of individual walnuts.
4. Study the drying efficiency and product quality with high air temperature and IR for partial drying.
5. Quantify the total energy saving and benefits of new processing methods.

It is expected that when the new walnut dehulling and drying methods are fully developed and implemented, the potential of natural gas and propane saving could be 2 million therms each year with an economic value of $2.9 million. In addition, it is certain that the proposed methods will also save electricity, water, and fuel for transportation, as well as labor. Our previous project on Energy Efficient Processing Method for Drying Fruits and Vegetables which was funded by the EISG program has led into the way of successful commercialization of the developed technology. Based on our expertise and experience and close collaboration with the walnut industry and the CWB, we also expect successful development of the proposed walnut processing methods and eventually commercialization.